

Performance Work Statement (PWS)

Radiation and Acceleration Physics Research Support Services

12/13/2012

Version 1.0

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Performance Work Statement (PWS)

PR#67-0824-12 Radiation and Acceleration Physics Research Support Services

Vision Statement

Develop theoretical, numerical and experimental techniques to solve basic plasma physics problems and assess potential applications for novel radiation sources and particle beam accelerators.

1 Introduction

The Beam Physics Branch (Code 6790) of the Plasma Physics Division uses and develops theoretical, numerical and experimental techniques to solve basic physics problems and assess potential applications of novel radiation sources and particle beam accelerators. The Branch presently studies a broad range of processes involved with the generation and propagation of intense beams and their interaction with materials. Specific research areas include pulsed laser propagation in gases and plasmas, nonlinear optics, laser-induced ionization, free-electron sources of radiation, novel x-ray and γ -ray sources, nuclear material detection, high-gradient accelerators, electron and ion beam transport, high power microwave sources, and microwave interaction with materials.

1.1 Mission

Naval Research Lab (NRL) Beam Physics Branch (Code 6790) program encompasses the integration of theoretical/computational and experimental research in the areas of advanced radiation and accelerator physics, space plasma physics, ultra high field laser physics and high frequency microwave research for processing ceramic materials.

Providers will work cooperatively with NRLs engineers and scientists performing theoretical/computational and experimental research in evaluation of coherent radiation sources, ultra high field laser-plasma interactions, and advanced (laser-plasma driven) accelerators.

In addition to computational analysis of experimental data, providers, as part of experiment set-up and execution, can be required to perform maintenance diagnostics on and operation of NRL furnished laser and microwave equipment including high power, coherent microwave sources and electron accelerators, a Table Terawatt (T3) laser, computing stations and a scientific computing center.

1.2 Background

The development of advanced sources of radiation and accelerators is of great interest in a wide variety of applications, ranging from scientific research, military and industrial systems, to medical and clinical procedures. New classes of radiation sources and accelerators have been conceived and studied that promise to vastly improve upon and extend the performance of existing technology. Availability of high-power sources of radiation and high-gradient accelerators has led to a tremendous surge in areas such as nonlinear optics and fundamental physics, with new and potentially revolutionary applications. Pulsed laser applications of interest include remote sensing and detection of pollutants, hazardous materials and weapons of mass destruction, ultrafast imaging, compact electron accelerators, directed energy weapons, laser-triggered electrical discharges, and plasma-based optical elements. High power microwave applications of interest include the production, bonding, and sintering of ceramics and other advanced materials, microwave sources for high gradient accelerators, and power beaming.

The Branch maintains several major experimental facilities and a number of smaller scale experiments. Much of the theoretical and computational research supports these experiments. The Branch currently has two ultrashort laser sources: the T3 laser, and the Ten-Hertz Femtosecond laser (TFL). The T3 laser currently produces a 400 fs long pulse at 1.054 micron wavelength with pulse energy of 5 joules and is used for ultra-intense laser propagation studies and laser-driven accelerators. The TFL laser currently produces a train of 50 fsec, 50 mJ, 0.8 micron pulses at a pulse repetition rate of 10 Hz, and will primarily be used to study laser propagation in the atmosphere. Construction of another major ultrashort pulse laser facility is currently under consideration. The Branch has a number of CW, kW-class fiber lasers for atmospheric propagation experiments. The Branch also has a 4.5 MeV RF electron gun that is co-located with the ultrashort pulse laser experiments. A separate facility houses several major high power microwave experiments. The microwave sources include an X-band magnicon, an active pulse compression experiment, and a high average power fixed frequency gyrotron. The gyrotron source is primarily used for materials processing applications.

The Branch has also developed several large-scale simulation codes. These include SAMI2 and SAMI3 to conduct ionospheric research, the HELCAP air propagation code, the turboWAVE particle simulation code, and the LEM cold fluid simulation code. There is an ongoing effort to improve algorithms, physical models, and diagnostics in these codes. This simulation effort is strongly tied to experiments in the Beam Physics Branch.

1.3 Scope

The purpose of this contract is to provide personnel to perform research in the areas described above. The basic research nature of the work requires the use of analytical, numerical and experimental techniques as well as computer hardware to study the various problem areas.

Efforts in support of the tasks delineated in Section 3, Performance Requirements, below will be conducted in coordination with Principal Investigator (PI) led research teams that may include government scientists and other contractors. The quality and timeliness of the Contractor's

contribution to the work will be evaluated in terms of its impact on the success of the overall project.

2 General Requirements

2.1 Non-Personal Services

The Government **will** neither supervise contractor employees nor control the method by which the contractor performs the required tasks.

The Government **will** not assign tasks to, or prepare work schedules for, individual contractor employees.

The Contractor **shall** be responsible for managing its employees and guarding against any actions that are of the nature of personal services, or give the perception of personal services as defined in FAR-Part 37, Service Contracting, dated 31 May 2011.

The Contractor shall notify the Contracting Officer (CO) if any Government requested actions constitute, or are perceived to constitute personal services.

2.2 Business Relations

The contractor **shall** integrate and coordinate all activity needed to execute this contract.

2.3 Contract Administration and Management

The following subsections specify requirements for contract management and contractor personnel administration

2.3.1 Contract Management

The Contractor **shall** establish clear organizational lines of authority and responsibility to ensure effective management of the resources assigned to this contract.

2.3.2 Contract Administration

The Contractor **shall** establish processes and assign appropriate resources to effectively administer this contract.

The Contractor **shall** respond to Government requests for contractual actions in a timely fashion.

The Contractor **shall** assign work effort and maintain proper and accurate time keeping records of personnel assigned to work on this contract.

2.3.3 Personnel Administration

The Contractor **shall** provide for employees during designated Government non-work days or other periods where Government offices are closed due to weather or security conditions.

The Contractor **shall** maintain the currency of their employees by providing initial and refresher training as required to meet the PWS requirements.

The Contractor **shall** make necessary travel arrangements for employees.

2.4 Contractor Furnished Equipment, Materials, Subcontracts and Supplies

Equipment and unexpended materials and supplies purchased by the contractor under this contract become the property of the Government at the end of the performance period, including all options.

The Contractor **shall** provide supplies for contractor personnel.

The Contractor **shall** provide any other equipment, material, and supplies, not furnished by the Government, but required to perform the work defined under Paragraph 3, Performance Requirements, below.

The Contractor **shall** be responsible for any subcontract management necessary for performing numerical or experimental studies required under Paragraph 3, Performance Requirements, below.

2.5 Contractor Personnel, Disciplines, and Specialties

The minimum education, training, and experience required by contractor personnel to perform support tasks identified in this PWS are defined in the labor category descriptions provided herein.

Principal Research Scientist/Engineer:

Ph.D. in physics or electrical engineering and at least 10 years related experience. This experience should include successful management of at least one major research project.

Experience in plasma physics, optics, accelerator technology, pulsed power physics and/or high power microwave sources and applications required.

Senior Research Scientist/Engineer:

PhD in physics or engineering and at least 5 years related experience in plasma physics, optics, accelerator technology, materials science, and/or high power microwave sources.

Research Scientist/Engineer:

Ph. D. in a physical science or engineering, or M.S. in a physical science or engineering and at least 3 years related experience in plasma physics, optics, accelerator technology, materials science, and/or high power microwave sources.

Technician:

B.S. /B.A. in a physical science, engineering, or computer science, or a minimum of 2 years experience in optics, electrical systems, laboratory diagnostics, or information technology.

Technical Documentation Specialist:

B.S. in a technical discipline or B.A, and 2 years experience or ten years experience in lieu of a degree, demonstrated capability to design, create, and maintain technical documentation using MS Office publishing applications.

2.6 Location and Hours of Work

Accomplishment of the results contained in this PWS requires work at the Naval Research Laboratory facilities, 4555 Overlook Ave, SW, Washington, DC 20375-5320. Normal workdays are Monday through Friday except US Federal Holidays. NRL workers typically work eight (8) hours per day, 40 hours per week. Flextime workers start not earlier than 0600 and not later than 0900. Core hours of work are from 0900 to 1500 daily. All employees are expected to be available during core hours. Additional information on work hours is provided in Section 1.(c), NRL HOURS OF OPERATION AND HOLIDAY SCHEDULE, in NRL Requirements for On-Site Contractors.

2.7 Travel / Temporary Duty (TDY)

Travel to other government facilities or contractor facilities may be required for conduct of experimental research or attendance at government reviews or scientific meetings and seminars.

The Contractor **shall** submit all travel requirements (including plans, agenda, itinerary and dates) for pre-approval to the Government and is on a strictly cost reimbursable basis.

The Contractor **shall** bill costs for travel in accordance with FAR 31.205-46 Travel Costs (subject to local policy & procedures).

3 Performance Requirements

The following section specifies the Performance Objectives and Performance Elements for the contract.

3.1 The Contractor shall conduct research on atmospheric propagation of intense laser pulses.

Work under this task area involves analytical, numerical, and experimental studies of the key physics issues associated with propagating intense laser pulses in the atmosphere. These issues include nonlinear effects, filamentation, dispersion, thermal blooming, turbulence, scattering, absorption and aerosols.

Performance Standards

a) STD: Timely

AQL: 5 days after last day of month in which work was accomplished

b) STD: Comprehensive

AQL: Include: hours expended on tasks, resources assigned to tasks, meeting/reviews attended, problems or issues encountered

c) STD: Timely

AQL: 60 days after the end of an annual period of performance.

d) STD: Comprehensive

AQL: Addresses key issues associated with modeling atmospheric propagation of intense laser beams.

Deliverables

A001 Monthly Progress and Status Report

A004 Contract Summary Technical Report

3.1.1 The Contractor shall perform theoretical research to develop analytical framework of numerical models for atmospheric propagation of intense laser beams.

Performance Standards

a) STD: Timely

AQL: 30 days after completion of development of a specific framework

b) STD: Comprehensive

AQL: Addresses key issues associated the analytical framework of the numerical model developed

Deliverables

A002 Studies Final Report

3.1.2 The Contractor shall conduct experimental research on simulation model code design, model execution, and interpretation of experimental data for propagation of intense laser beams in the atmosphere.

Performance Standards

a) STD: Timely

AQL: 30 days after completion of a specific experiment

b) STD: Comprehensive

AQL: Addresses key issues associated with a specific experiment

Deliverables

A002 Studies Final Report

3.1.3 The Contractor shall conduct research into and provide recommendations on potential applications for ultra-short pulse lasers and CW fiber lasers.

Performance Standards

a) STD: Timely

AQL: 30 days after completion of analysis

b) STD: Comprehensive

AQL: Provide detailed assessment of potential applications.

Deliverables

A002 Studies Final Report

3.2 The Contractor shall conduct research on high-gradient laser driven acceleration processes.

The Laser Wakefield Accelerator (LWFA) is an example of a high-gradient accelerator and represents the mainline effort at the NRL. Studies address issues such as all-optical injectors, particle trapping, optical guiding, plasma channels, particle acceleration, beam loading and efficiency.

Performance Standards

a) STD: Timely

AQL: 5 days after last day of month in which work was accomplished

b) STD: Comprehensive

AQL: Include: hours expended on tasks, resources assigned to tasks, meeting/reviews attended, problems or issues encountered

c) STD: Timely

AQL: 60 days after the end of an annual period of performance.

d) STD: Comprehensive

AQL: Addresses key issues associated with conduct of simulations/experiments with high gradient laser-driven accelerators

Deliverables

A001 Monthly Progress and Status Report

A004 Contract Summary Technical Report

3.2.1 The Contractor shall perform theoretical research to develop analytical framework of numerical models for treating high gradient laser-driven processes in LWFAs and other optical injectors.

Performance Standards

a) STD: Timely

AQL: 30 days after completion of development of a specific framework

b) STD: Comprehensive

AQL: Addresses key issues associated the analytical framework of the numerical model developed

Deliverables

A002 Studies Final Report

3.2.2 The Contractor shall design and implement numerical simulation code based on the results of task 3.2.1 above for use in LWFA and other optical injector experiments.

Performance Standards

a) STD: Timely

AQL: 30 days after completion of verification and validation of simulation code

b) STD: Comprehensive

AQL: Meets 100% of the requirements listed in the VDD Guide data description provided in the DD1423 Contract Requirements Data List (CDRL) attached.

Deliverables

A003 Software Version Description Document (VDD)

3.2.3 The Contractor shall conduct experimental research on simulation model code design, model execution, and interpretation of experimental data for LWFA and capillary plasma channel guiding experiments.

Performance Standards

a) STD: Timely

AQL: 30 days after completion of a specific experiment

b) STD: Comprehensive

AQL: Addresses key issues and findings associated with a specific experiment.

Deliverables

A002 Studies Final Report

3.3 The Contractor shall conduct research on fundamental plasma and optical physics processes.

Research in this area encompasses analytical numerical and experimental studies of photo-ionization, nonlinear self-focusing due to the optical Kerr effect, stimulated Raman scattering, relativistic self-focusing, harmonic generation, self-phase modulation, spectral broadening, optical guiding in plasma channels, and plasma-based laser pulse control methods. Of particular interest is the application of these processes in DoD related operations, such as the generation of THz radiation for remote sensing and detection. Research is also being carried out in the area of nonlinear optical properties in a nanostructured 3-dimensional metamaterial at optical/IR wavelengths. Additional areas include weak turbulence, effects of nonlinear scattering on radiation belt properties, employing the NRL ionosphere models SAMI2 and SAMI3 to conduct ionospheric research to: (1) model the impact of high-power radio wave heating on the ionosphere and its effects on radio wave propagation using ray-tracing methods, (2) develop new algorithms to model high-latitude ionospheric processes such as ion outflow, and (3) improve SAMI3 by coupling it to other space physics models and incorporate empirical physical models such as the Weimer potential model.

Performance Standards

a) STD: Timely

AQL: 5 days after last day of month in which work was accomplished

b) STD: Comprehensive

AQL: Include: hours expended on tasks, resources assigned to tasks, meeting/reviews attended, problems or issues encountered

c) STD: Timely

AQL: 60 days after the end of an annual period of performance.

d) STD: Comprehensive

AQL: Addresses key issues associated with modeling fundamental plasma and optical processes.

Deliverables

A001 Monthly Progress and Status Report

A004 Contract Summary Technical Report

3.3.1 The Contractor shall develop improved analytical and numerical methods for modeling the fundamental processes described in the paragraph 3.3 above.

Performance Standards

a) STD: Timely

AQL: 30 days after completion of development of specific analytical or numerical methods

b) STD: Comprehensive

AQL: Addresses specific analytical or numerical method improvements for use in modeling of fundamental plasma and optical physical processes.

Deliverables

A002 Studies Final Report

3.3.2 The Contractor shall modify improved numerical models validated by task 3.3.1 experiments for incorporation into large scale simulation codes being developed by NRL Beam Physics Branch.

Performance Standards

a) STD: Timely

AQL: 30 days after validation of a specific large scale model update.

b) STD: Comprehensive

AQL: Addresses key issues associated with incorporating improved analytical and numerical models of fundamental plasma and optical processes into NRL large scale simulation codes.

c) STD: Comprehensive

AQL: Meets 100% of the requirements listed in the VDD Guide data description provided in the DD1423 Contract Requirements Data List (CDRL) attached.

Deliverables

A002 Studies Final Report

A003 Software Version Description Document (VDD)

3.4 The Contractor shall conduct research on electron beam driven radiation sources.

The Branch has an ongoing interest in tunable, electron beam driven radiation sources such as the free electron laser (FEL) and laser synchrotron x-ray and γ -ray source.

Performance Standards

a) STD: Timely

AQL: 5 days after last day of month in which work was accomplished

b) STD: Comprehensive

AQL: Include: hours expended on tasks, resources assigned to tasks, meeting/reviews attended, problems or issues encountered

c) STD: Timely

AQL: 60 days after the end of an annual period of performance.

d) STD: Comprehensive

AQL: Addresses key issues associated with modeling electron beam driven radiation sources..

Deliverables

A001 Monthly Progress and Status Report

A004 Contract Summary Technical Report

3.4.1 The Contractor shall develop analytical and numerical models for evaluating FEL electron beam dynamics and radiation generation.

Models cover both the near infrared (IR) wavelength regime of the high average power FEL at the Thomas Jefferson National Laboratory as well as proposed FELs operating in the soft x-ray regime.

Performance Standards

a) STD: Timely

AQL: 30 days after completion of development of a specific model

b) STD: Comprehensive

AQL: Addresses analytical capability of a specific model in simulating FEL operations

c) STD: Comprehensive

AQL: Meets 100% of the requirements listed in the VDD Guide data description provided in the DD1423 Contract Requirements Data List (CDRL) attached.

Deliverables

A002 Studies Final Report

A003 Software Version Description Document (VDD)

3.4.2 The Contractor shall conduct experimental research on simulation model code design, model execution, and interpretation of experimental data for the NRL laser synchrotron x-ray and γ -ray source experiments..

Performance Standards

a) STD: Timely

AQL: 30 days after completion of a specific experiment

b) STD: Comprehensive

AQL: Addresses key issues and findings associated with a specific experiment.

Deliverables

A002 Studies Final Report

3.4.3 The Contractor shall evaluate use of electron beam sources for potential dual use applications.

(Examples of possible dual use applications include (1) military: detection of nuclear materials and weapons of mass destruction (2) commercial: mammography, angiography, biological imaging, and ultrafast chemical kinetics.)

Performance Standards

a) STD: Timely

AQL: 30 days after completion of a specific evaluation

b) STD: Comprehensive

AQL: Addresses key findings associated with an assessment of dual use applications for electron beam sources.

Deliverables

A002 Studies Final Report

3.5 The Contractor shall conduct development of and research on applications for high power microwave, millimeter wave, and Terahertz sources.

The Branch has high-power sources of microwaves and millimeter waves that have widespread applications such as testing of accelerator modules in the X-band regime, for materials synthesis and processing of ceramic materials. Of particular interest is the use of focusable millimeter waves to provide localized heating for bonding ceramics and other advanced materials. High average power terahertz sources are of interest for remote detection of improvised explosive devices (IED) and advanced material processing applications.

Performance Standards

a) STD: Timely

AQL: 5 days after last day of month in which work was accomplished

b) STD: Comprehensive

AQL: Addresses key issues associated with modeling and operating high power microwave, millimeter-wave, and terahertz sources and applications,

c) STD: Timely

AQL: 60 days after the end of an annual period of performance.

d) STD: Comprehensive

AQL: Include: hours expended on tasks, resources assigned to tasks, meeting/reviews attended, problems or issues encountered

Deliverables

A001 Monthly Progress and Status Report

A004 Contract Summary Technical Report

3.5.1 The Contractor shall design and operate experiments for microwave and millimeter wave processing of ceramics and other materials.

Performance Standards

a) STD: Timely

AQL: 30 days after completion of a specific experiment

b) STD: Comprehensive

AQL: Addresses key issues and findings associated with designing and conducting a specific experiment.

Deliverables

A002 Studies Final Report

3.5.2 The Contractor shall conduct experimental research on simulation model code design, model execution, and interpretation of experimental data for microwave and millimeter wave material processing experiments.

Performance Standards

a) STD: Timely

AQL: 30 days after completion of a specific data collection effort.

b) STD: Comprehensive

AQL: Addresses key findings associated with an assessment of a specific set of data..

Deliverables

A002 Studies Final Report

3.5.3 The Contractor shall provide recommendations on and conduct research into potential material processing applications and other applications for microwave, millimeter wave, and magnicon sources.

Performance Standards

a) STD: Timely

AQL: 30 days after completion of a specific evaluation

b) STD: Comprehensive

AQL: Addresses key issues of proposed, potential applications for millimeter wave and magnicon sources.

Deliverables

A002 Studies Final Report

3.6 The Contractor shall perform engineering support for NRL laser and microwave facilities.

The laser facilities at NRL covered under this task area include the kW-class, CW fiber lasers, the 10 TW, 400 fs, Nd:glass, 1 mm T3 laser, and the 10 TW, Ti: sapphire, ten Hertz, femtosecond laser (TFL). The microwave facilities at NRL include the high frequency microwave processing system. Additional facilities covered under this task area include existing vacuum systems, pulsed or CW power circuits, optical or microwave transport systems, and target chambers.

3.6.1 The Contractor shall set-up, operate, run maintenance diagnostics routines, and perform routine maintenance of current NRL Laser and Microwave GFE for conduct of assigned experiments.

Performance Standards

a) STD: Timely

AQL: Tasks are completed in accordance with a monthly schedule provided by NRL.

b) STD: Responsive

AQL: Requisite personnel provided in accordance with a monthly schedule provided by NRL.

c) STD: Effective

AQL: Contractor personnel require no training to perform tasks assigned

Deliverables

A001 Monthly Progress and Status Report

3.6.2 The Contractor shall participate in planning, installation, and testing of proposed upgrades for NRL laser and microwave GFE when requested by the Government.

The laser facilities at NRL covered under this task area include the kW-class, CW fiber lasers, the 10 TW, 400 fs, Nd:glass, 1 micron T3 laser, and the 10 TW, Ti: sapphire, ten Hertz, femtosecond laser (TFL). The microwave facilities at NRL include the high frequency microwave processing system. Additional facilities covered under this task area include existing vacuum systems, pulsed or CW power circuits, optical or microwave transport systems, and target chambers.

Performance Standards

a) STD: Timely

AQL: 5 days after last day of month in which work was accomplished

b) STD: Responsive

AQL: Provide resources within 5 days of request for new task

In accordance with NRL schedule for continuing task lasting over a month

c) STD: Timely

AQL: 60 days after the end of an annual period of performance.

d) STD: Comprehensive

AQL: Addresses key issues associated with laser and microwave facilities upgrade support.

Covers minor short term upgrades for existing facilities and long term proposed new major facilities upgrades

Deliverables

A001 Monthly Progress and Status Report

4 Special Requirements

This section describes the special requirements for this effort. The following sub-sections provide details of various considerations on this effort,

4.1 Security

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4.2 Safety

The contractor **shall** comply with safety requirements of Section 9, Radiation Safety, of NRL Requirements for On-Site Contractors document, dated 8 December 2008.

4.3 Transition

The Contractor **shall** follow the transition plan submitted as part of the proposal and keep the Government fully informed of status throughout the transition period.

4.4 Government Furnished Materials

The Contractor **shall** perform this effort at the U.S. Naval Research Laboratory, Washington D.C. government furnished facilities.

4.5 Applicable Directives

The contractor shall comply with all documents listed below as mandatory and referenced under paragraph 3.0, Performance Requirements. Compliance with documents listed as non-mandatory is at the contractors' option.

5 Deliverables

The contractor **shall** provide deliverables with the schedule and format as described in section 3.0 of this contract and outlined in the CDRL's listed below.

Identifier	Name	Description
A001	Monthly Progress and Status Report	Indicates the progress of the contractor's work and the status of the program and of the assigned tasks, reports costs, and informs of existing or potential problem areas per contractor format..

A002	Studies Final Report	Provides fully documented results of studies or analysis performed per contractor format.
A003	Software Source Code	Source code to definitize in contractor format with content as per DD1423 Software Version Description Document (VDD) Guide
A004	Contract Summary Technical Report	Provides report of all technical work accomplished during the period of performance per contractor format.

6 Related Documents

The following Documents are related to this project

Naval Research Lab Requirements for On-site Contractors dated 08 Dec 2012
Provides basic requirements for contractor access to and use of NRL facilities.

FAR Part 37 Services Contracting dated 31 May 2011
Provides definition and description of personal services in support of Government entities.

FAR Part 31 Section 205-46 Travel Costs
Provides instructions on per diem rates and allowability of travel.

Performance Requirement Summary (PRS)

Statements	Standards/AQLs
<p>3.1 The Contractor shall conduct research on atmospheric propagation of intense laser pulses</p>	<p>a) Timely AQL: 5 days after last day of month in which work was accomplished</p> <p>b) Comprehensive AQL: Include: hours expended on tasks, resources assigned to tasks, meeting/reviews attended, problems or issues encountered</p> <p>c) Timely AQL: 60 days after the end of an annual period of performance.</p> <p>d) Comprehensive AQL: Addresses key issues associated with modeling atmospheric propagation of intense laser beams.</p>
<p>3.1.1 The Contractor shall perform theoretical research to develop analytical framework of numerical models for atmospheric propagation of intense laser beams.</p>	<p>a) Timely AQL: 30 days after completion of development of a specific framework</p> <p>b) Comprehensive AQL: Addresses key issues associated the analytical framework of the numerical model developed</p>
<p>3.1.2 The Contractor shall conduct experimental research on simulation model code design, model execution, and interpretation of experimental data for propagation of intense laser beams in the atmosphere.</p>	<p>a) Timely AQL: 30 days after completion of a specific experiment</p> <p>b) Comprehensive AQL: Addresses key issues associated with a specific experiment</p>
<p>3.1.3 The Contractor shall conduct research into and provide recommendations on potential applications for ultra-short pulse lasers and CW fiber lasers.</p>	<p>a) Timely AQL: 30 days after completion of analysis</p> <p>b) Comprehensive AQL: Provide detailed assessment of potential applications.</p>

Statements	Standards/AQLs
<p>3.2 The Contractor shall conduct research on high-gradient laser driven acceleration processes.</p>	<p>a) Timely AQL: 5 days after last day of month in which work was accomplished</p> <p>b) Comprehensive AQL: Include: hours expended on tasks, resources assigned to tasks, meeting/reviews attended, problems or issues encountered</p> <p>c) Timely AQL: 60 days after the end of an annual period of performance.</p> <p>d) Comprehensive AQL: Addresses key issues associated with conduct of simulations/experiments with high gradient laser-driven accelerators</p>
<p>3.2.1 The Contractor shall perform theoretical research to develop analytical framework of numerical models for treating high gradient laser-driven processes in LWFAs and other optical injectors.</p>	<p>a) Timely AQL: 30 days after completion of development of a specific framework</p> <p>b) Comprehensive AQL: Addresses key issues associated the analytical framework of the numerical model developed</p>
<p>3.2.2 The Contractor shall design and implement numerical simulation code based on the results of task 3.2.1 above for use in LWFA and other optical injector experiments.</p>	<p>a) Timely AQL: 30 days after completion of verification and validation of simulation code</p> <p>b) Comprehensive AQL: Meets 100% of the requirements listed in the VDD Guide data description provided in the DD1423 Contract Requirements Data List (CDRL) attached.</p>
<p>3.2.3 The Contractor shall conduct experimental research on simulation model code design, model execution, and interpretation of experimental data for LWFA and capillary plasma channel guiding experiments.</p>	<p>a) Timely AQL: 30 days after completion of a specific experiment</p> <p>b) Comprehensive AQL: Addresses key issues and findings associated with a specific experiment.</p>

Statements	Standards/AQLs
<p>3.3 The Contractor shall conduct research on fundamental plasma and optical physics processes.</p>	<p>a) Timely AQL: 5 days after last day of month in which work was accomplished</p> <p>b) Comprehensive AQL: Include: hours expended on tasks, resources assigned to tasks, meeting/reviews attended, problems or issues encountered</p> <p>c) Timely AQL: 60 days after the end of an annual period of performance.</p> <p>d) Comprehensive AQL: Addresses key issues associated with modeling fundamental plasma and optical processes.</p>
<p>3.3.1 The Contractor shall develop improved analytical and numerical methods for modeling the fundamental processes described in the paragraph 3.3 above.</p>	<p>a) Timely AQL: 30 days after completion of development of specific analytical or numerical methods</p> <p>b) Comprehensive AQL: Addresses specific analytical or numerical method improvements for use in modeling of fundamental plasma and optical physical processes.</p>
<p>3.3.2 The Contractor shall modify improved numerical models validated by task 3.3.1 experiments for incorporation into large scale simulation codes being developed by NRL Beam Physics Branch.</p>	<p>a) Timely AQL: 30 days after validation of a specific large scale model update.</p> <p>b) Comprehensive AQL: Addresses key issues associated with incorporating improved analytical and numerical models of fundamental plasma and optical processes into NRL large scale simulation codes.</p> <p>c) Comprehensive AQL: Meets 100% of the requirements listed in the VDD Guide data description provided in the DD1423 Contract Requirements Data List (CDRL) attached.</p>

Statements	Standards/AQLs
<p>3.4 The Contractor shall conduct research on electron beam driven radiation sources.</p>	<p>a) Timely AQL: 5 days after last day of month in which work was accomplished</p> <p>b) Comprehensive AQL: Include: hours expended on tasks, resources assigned to tasks, meeting/reviews attended, problems or issues encountered</p> <p>c) Timely AQL: 60 days after the end of an annual period of performance.</p> <p>d) Comprehensive AQL: Addresses key issues associated with modeling electron beam driven radiation sources..</p>
<p>3.4.1 The Contractor shall develop analytical and numerical models for evaluating FEL electron beam dynamics and radiation generation.</p>	<p>a) Timely AQL: 30 days after completion of development of a specific model</p> <p>b) Comprehensive AQL: Addresses analytical capability of a specific model in simulating FEL operations</p> <p>c) Comprehensive AQL: Meets 100% of the requirements listed in the VDD Guide data description provided in the DD1423 Contract Requirements Data List (CDRL) attached.</p>
<p>3.4.2 The Contractor shall conduct experimental research on simulation model code design, model execution, and interpretation of experimental data for the NRL laser synchrotron x-ray and γ-ray source experiments.</p>	<p>a) Timely AQL: 30 days after completion of a specific experiment</p> <p>b) Comprehensive AQL: Addresses key issues and findings associated with a specific experiment.</p>
<p>3.4.3 The Contractor shall evaluate use of electron beam sources for potential dual use applications.</p>	<p>a) Timely AQL: 30 days after completion of a specific evaluation</p> <p>b) Comprehensive AQL: Addresses key findings associated with an assessment of dual use applications for electron beam sources.</p>

Statements	Standards/AQLs
<p>3.5 The Contractor shall conduct development of and research on applications for high power microwave, millimeter wave, and Terahertz sources.</p>	<p>a) Timely AQL: 5 days after last day of month in which work was accomplished</p> <p>b) Comprehensive AQL: Addresses key issues associated with modeling and operating high power microwave, millimeter-wave, and terahertz sources and applications,</p> <p>c) Timely AQL: 60 days after the end of an annual period of performance.</p> <p>d) Comprehensive AQL: Include: hours expended on tasks, resources assigned to tasks, meeting/reviews attended, problems or issues encountered</p>
<p>3.5.1 The Contractor shall design and operate experiments for microwave and millimeter wave processing of ceramics and other materials.</p>	<p>a) Timely AQL: 30 days after completion of a specific experiment</p> <p>b) Comprehensive AQL: Addresses key issues and findings associated with designing and conducting a specific experiment.</p>
<p>3.5.2 The Contractor shall conduct experimental research on simulation model code design, model execution, and interpretation of experimental data for microwave and millimeter wave material processing experiments.</p>	<p>a) Timely AQL: 30 days after completion of a specific data collection effort.</p> <p>b) Comprehensive AQL: Addresses key findings associated with an assessment of a specific set of data.</p>
<p>3.5.3 The Contractor shall provide recommendations on and conduct research into potential material processing applications and other applications for microwave, millimeter wave, and magnicon sources.</p>	<p>a) Timely AQL: 30 days after completion of a specific evaluation</p> <p>b) Comprehensive AQL: Addresses key issues of proposed, potential applications for millimeter wave and magnicon sources.</p>

Statements	Standards/AQLs
3.6 The Contractor shall perform engineering support for NRL laser and microwave facilities.	
3.6.1 The Contractor shall set-up, operate, run maintenance diagnostics routines, and perform routine maintenance of current NRL Laser and Microwave GFE for conduct of assigned experiments.	<p>a) Timely AQL: Tasks are completed in accordance with a monthly schedule provided by NRL.</p> <p>b) Responsive AQL: Requisite personnel provided in accordance with a monthly schedule provided by NRL.</p> <p>c) Effective AQL: Contractor personnel require no training to perform tasks assigned.</p>
3.6.2 The Contractor shall participate in planning, installation, and testing of proposed upgrades for NRL laser and microwave GFE when requested by the Government.	<p>a) Timely AQL: 5 days after last day of month in which work was accomplished</p> <p>b) Responsive AQL: Provide resources within 5 days of request for new task In accordance with NRL schedule for continuing task lasting over a month</p> <p>c) Timely AQL: 60 days after the end of an annual period of performance.</p> <p>d) Comprehensive AQL: Addresses key issues associated with laser and microwave facilities upgrade support. Covers minor short term upgrades for existing facilities and long term proposed new major facilities upgrades</p>